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Short Communication

Xanthium Leaf Movements in Light and Dark[1]

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Bunning suggested that circadian rhythms provide the basis for time measurement in the photoperiodic responses of plants (2). A classic example is found in *Glycine max.* L. Merr. (Biloxi soybean), whose flowering response occurs in a rhythmical form having peaks of flowering that were approximately 24 hr apart (6). Recently Moore *et al.* (5) reported that *Xanthium pensylvanicum* did not exhibit a rhythmic flowering response when the plants were subjected to red light breaks and dark periods of various lengths. Likewise Reid *et al.* (7) found that red and far-red light perturbations did not result in a rhythmic type of flowering response. The results of Moore *et al.* (5) and Reid *et al.* (7) neither contradicted nor supported Bunning's hypothesis (2). However, in this respect Moore *et al.* (5) have hypothesized that although no clear evidence for a flowering rhythm was found, the results were compatible with a rhythm that damped rapidly within 1 cycle. It was felt that an investigation of leaf movements might provide information as to the nature of the rhythmic process in *Xanthium.* From such information a clarification of the photoperiodic response of *Xanthium* might be possible.

Plants of *Xanthium pensylvanicum* (Wallr.)[2] used in these experiments were grown from seeds obtained in the Chicago area. The cultural conditions and methods were similar to those used by previous investigators in this laboratory (7). In preliminary experiments it was found that the young leaves which are in the rapid expansion stage had the greatest amplitude of movement in both continuous darkness (DD) and continuous light (LL). For this reason young leaves in the rapid expansion stage were selected for data collection. The leaf movements were measured with kymographs. On the graphs obtained in this manner an upward movement of the leaf is indicated by a downward movement of the curve and *vice-versa.*

Sets of 4 plants each were given 4 days of continuous light preceded by 4 days of various light-dark treatments (DD, 8L:16D, 10L:14D, 12L:12D, 14L:10D, 16L:8D). Light controlled rooms were used whose temperature was maintained at 28° ± 1° during the light period (750 ft-c) and 22° ± 1° during the dark period. Regardless of pretreatments of either light-dark cycles or continuous dark, the phase of the leaf movements was determined by the beginning of the continuous light period (fig 1). The leaf movements during the continuous light period were characterized by epinastic curvature occurring rhythmically with a period of approximately 24 hr.

Subsequent sets of 4 plants each were given 4 days of continuous darkness preceded by 4, 8, 25, or 30 days of continuous light. A growth chamber was used whose temperature was maintained at 25° + 0.5° during the light (750 ft-c) and dark periods. The phase of the leaf movements was determined by the beginning of the continuous dark period (fig 2). The movements during continuous darkness were characterized by a rhythmic upward movement of the leaf from the horizontal position and back. As in the continuous light experiment the period of the rhythm was approximately 24 hr. The movements were also observed in experiments conducted at other temperatures.

These 2 distinct leaf movement rhythms, one occurring in light and the other in darkness, are indicative of the existence of a "light-on" (fig 1) and a "light-off" rhythm (fig 2) in the leaf movements of *Xanthium pensylvanicum.* Similar responses involving "light-on" and "light-off" rhythms have been reported in the flowering response of *Pharbitis nil* (8) and the petal movement of *Kalanchoe* (4).

Since the amplitude of the "light-off" leaf movement rhythm is rapidly damped (fig 2) it might be hypothesized that a similar rapidly damping rhythm is present in the flowering response. Support for this hypothesis may be seen in the similarity between the petal movement rhythm in *Kalanchoe* and its flowering rhythm (3); and the leaf movement

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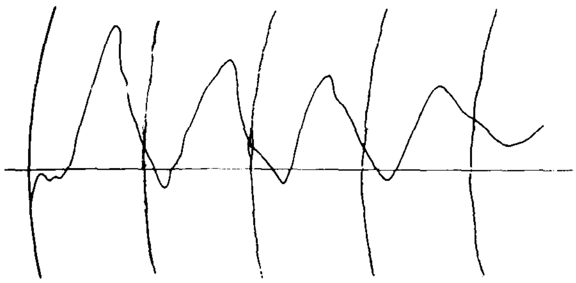
[2] The latest accepted name is *Xanthium strumarium* L.

rhythm in soybean and its flowering rhythm (1). The low amplitude rhythmic flowering response in *Xanthium*, if it is present, may be completely masked by the deviations found when measuring the flowering response. This is possibly the reason that Moore *et al.* (5) were unable to demonstrate a clear rhythmic response and gives support to their hypothesis that a rapidly damping flowering rhythm may exist in *Xanthium*.



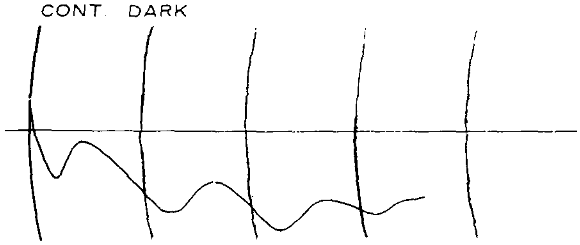


FIG. 1. *Xanthium* leaf movements in continuous light. The curve represents the average movement of 24 leaves, each being the most rapidly expanding leaf on a plant. Plants were pretreated with 4 days of DD, 8L:16D, 10L:14D, 12L:12D, 14L:10D, or 16L:8D. The heavy curved line represents the beginning of continuous light. The light curved lines represent 24 hr intervals. The upward movement of the leaf is indicated by a downward movement of the kymograph curve and *vice-versa*.

FIG. 2. *Xanthium* leaf movements in continuous dark. The curve represents the average movements of 20 leaves, each being the most rapidly expanding leaf on a plant. Plants were pretreated with 4, 8, 25, or 30 days of continuous light. The heavy vertical curved line represents the beginning of continuous dark. The light curved lines represent 24 hr intervals.

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